

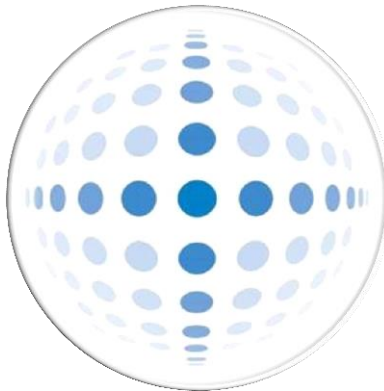
# Computer Networks



# Network Reference Models

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LECTURE (2)



# Network Reference Models

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- ➔ A framework (guideline) for network implementation and troubleshooting.
- ➔ Divides complex functions into simpler components.
- ➔ Importance of reference model:
  - Vendor interoperability “standardization”.
  - Better understanding of data transfer
- ➔ Reference model types :
  - ✓ OSI (Open System Interconnection ).
  - ✓ TCP/IP (DOD Model)

# Advantages of R.M

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- ➡ It divides the network communication process into smaller and simpler components, thus aiding component development, design, and troubleshooting.
- ➡ It allows multiple-vendor development through standardization of network components.
- ➡ It encourages industry standardization by defining what functions occur at each layer of the model.
- ➡ It allows various types of network hardware and software to communicate.
- ➡ It prevents changes in one layer from affecting other layers, so it does not hamper development.

# OSI Reference Model

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➡ OSI: Open Systems Interconnection

➡ The OSI model is the primary architectural model for networks.

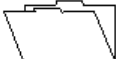






➡ It describes how data and network information are communicated from an application on one computer, through the network media, to an application on another computer.

➡ The model was defined by the International Organization for Standardization (ISO)

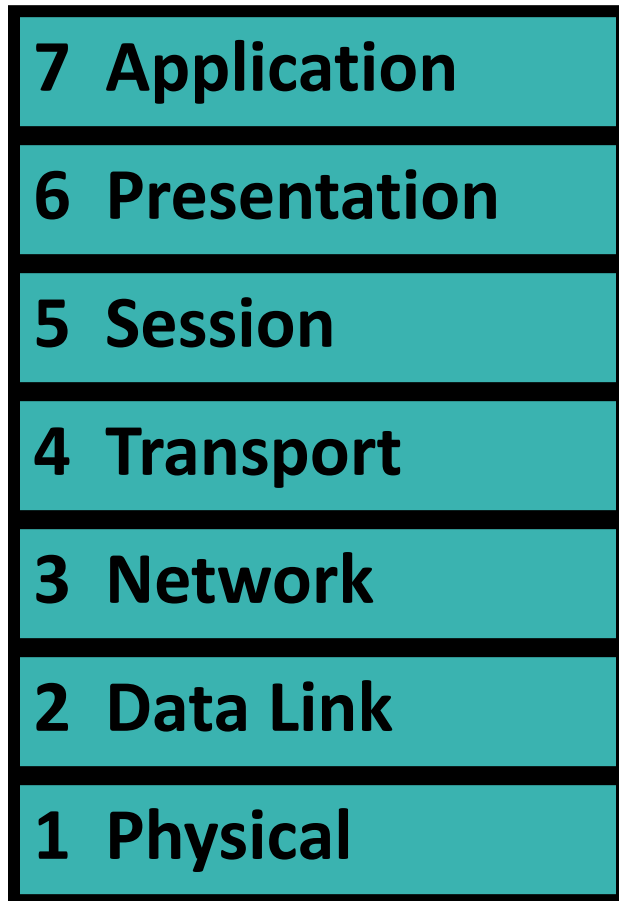
➡ The OSI reference model breaks this approach into layers.

# OSI Reference Model (cont.)



OSI MODEL		TCP / IP
7	 <b>Application Layer</b> Type of communication: E-mail, file transfer, client/server.	FTP, SMTP, DNS, Telnet
6	 <b>Presentation Layer</b> Encryption, data conversion: ASCII to EBCDIC, BCD to binary, etc.	
5	 <b>Session Layer</b> Starts, stops session. Maintains order.	
4	 <b>Transport Layer</b> Ensures delivery of entire file or message.	TCP (delivery ensured) UDP (delivery NOT ensured)
3	 <b>Network Layer</b> Routes data to different LANs and WANs based on network address.	IP (ICMP, ARP, RARP)
2	 <b>Data Link (MAC) Layer</b> Transmits packets from node to node based on station address.	
1	 <b>Physical Layer</b> Electrical signals and cabling.	

# Layer 7 - The Application Layer



• It's the S\w on our pcs that is used to represent a user interface to the network & so aids the user to make applications.

Examples:

- Email (SMTP, POP3)
- Web browsers (HTTP)
- FTP
- Telnet

# Layer 6 - The Presentation Layer

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**7 Application**

**6 Presentation**

**5 Session**

**4 Transport**

**3 Network**

**2 Data Link**

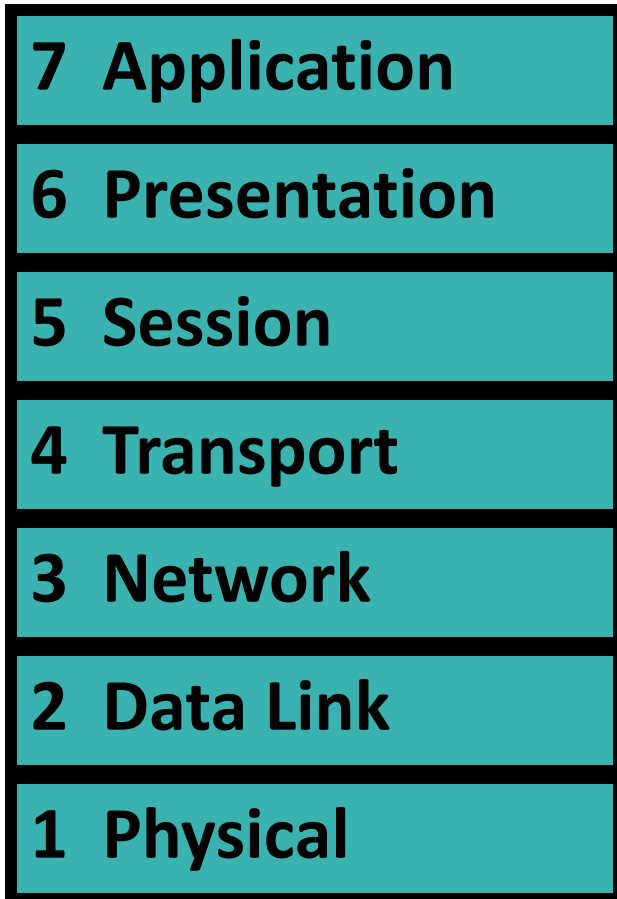
**1 Physical**

**This layer is responsible for presenting the data in the proper format .**

**Examples:  
ASCII, AVI,JPG,....**

# Layer 5 - The Session Layer

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- Ensure that all information required for opening a session is available.
- Give orders for: establishment, management, and termination of the session.



# Layer 4 - The Transport Layer

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**7 Application**

**6 Presentation**

**5 Session**

**4 Transport**

**3 Network**

**2 Data Link**

**1 Physical**

- Responsible for actual mechanism of:
  1. Establishment of connection.
  2. Management of connection:
    - 2.1) segmentation.
    - 2.2) sequencing.
    - 2.3) end-to-end check.
    - 2.4) error detection & correction.
    - 2.5) flow control.
  3. Termination of connection.

Examples:

- TCP (transmission control protocol).
- UDP (User Datagram Protocol).

# Layer 3 - The Network Layer

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**7 Application**

**6 Presentation**

**5 Session**

**4 Transport**

**3 Network**

**2 Data Link**

**1 Physical**

**Responsible for:**

**1. End-to-end delivery.**

**2. Logical addressing .**

**EX: IPv4,IPv6,IPX,APPLETALK**

**3. Routing (choose the best path to destination.)**

**EX: RIP,OSPF,IS-IS,EIGRP**

# Layer 2 - The Data Link Layer

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**7 Application**

**6 Presentation**

**5 Session**

**4 Transport**

**3 Network**

**2 Data Link**

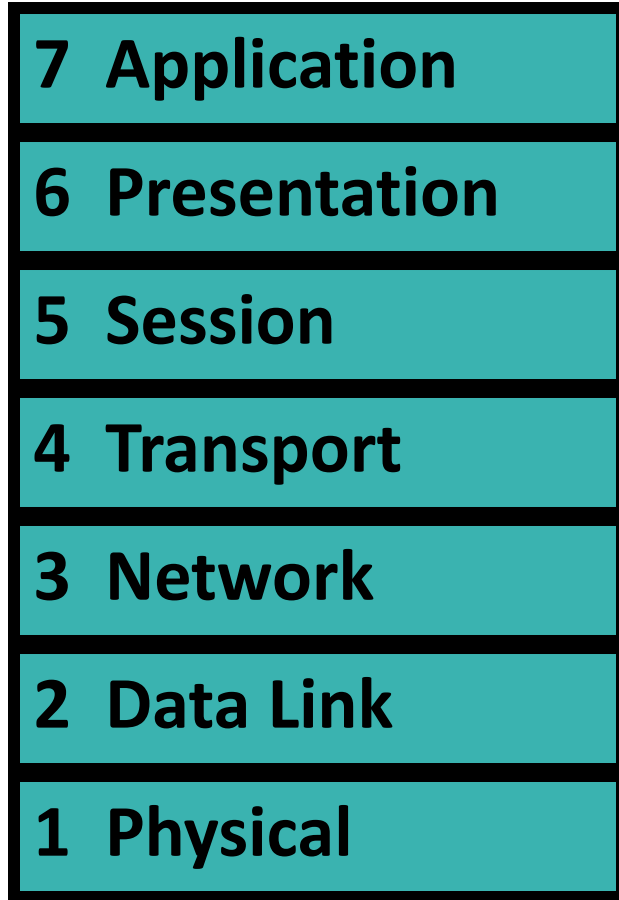
**1 Physical**

**Responsible for:**

- 1. Hop-to hop data delivery.**
- 2. Hop-to-hop addressing (MAC Address in Ethernet).**
- 3. Hop-to-hop error detection**
- 4. Hop-to-hop flow control.**

# Layer 1 - The Physical Layer

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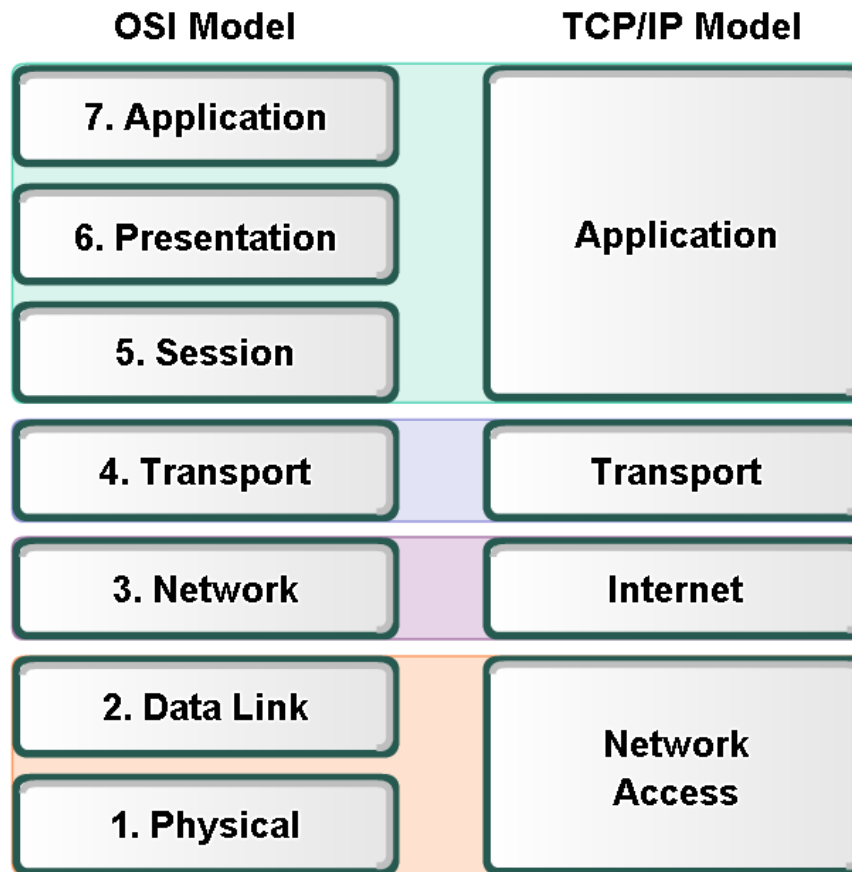


It's responsible for all Physical properties of the network :

1. Cable length.
2. Cable type.
3. Bit rate.
4. Voltage levels.
5. H/W interface types.

# Layers with TCP/IP and OSI Model

➡ Compare OSI and TCP/IP model



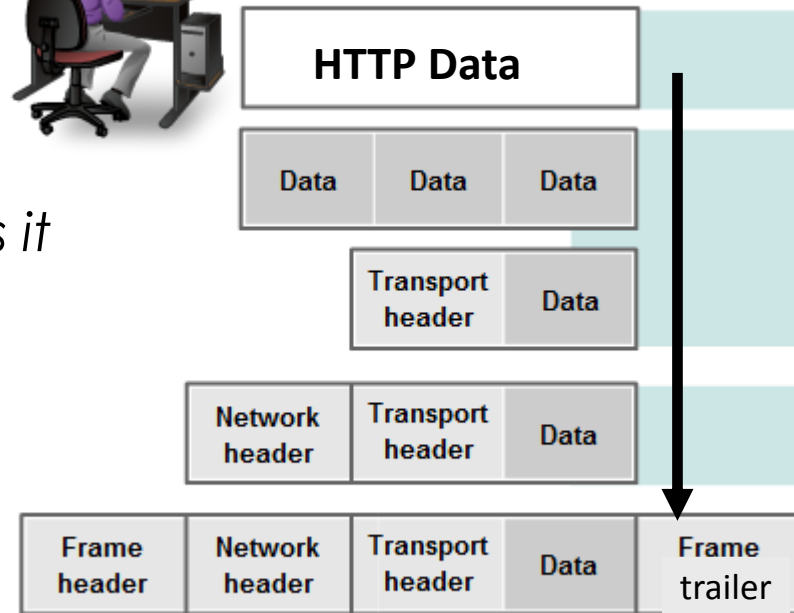
# Encapsulation



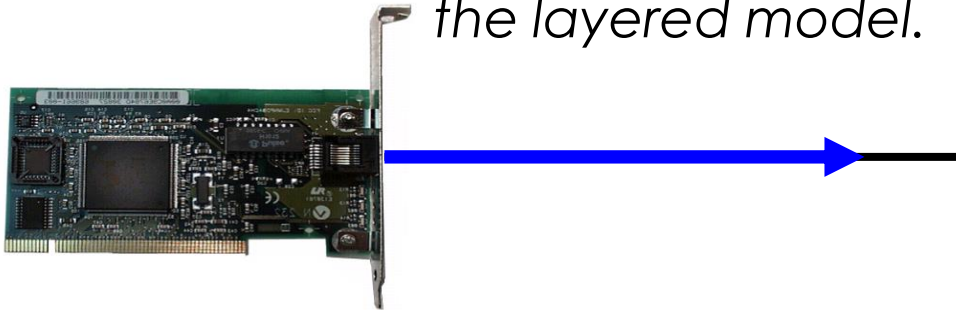
Server



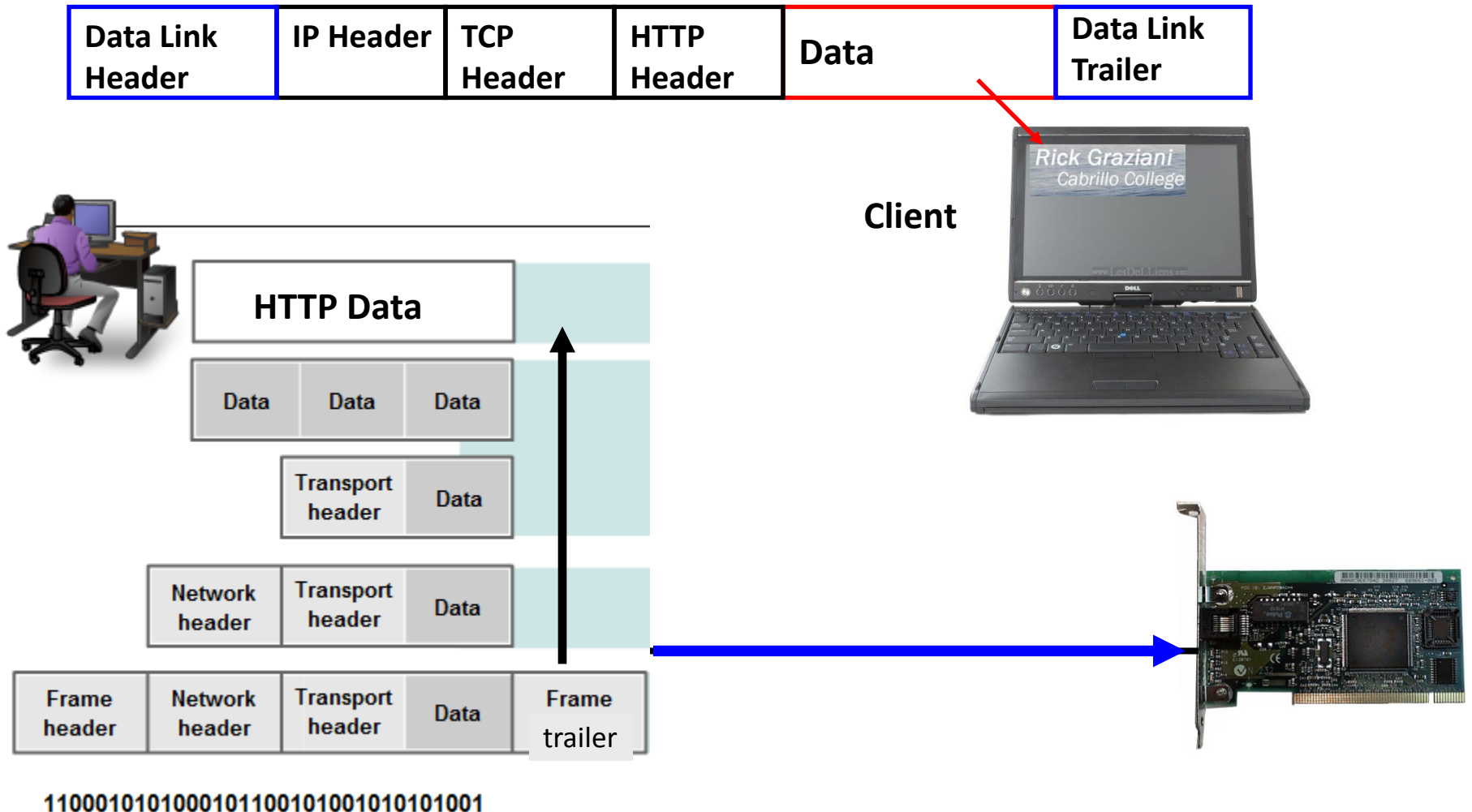
➔ **Encapsulation** –  
*Process of adding control information as it passes down through the layered model.*



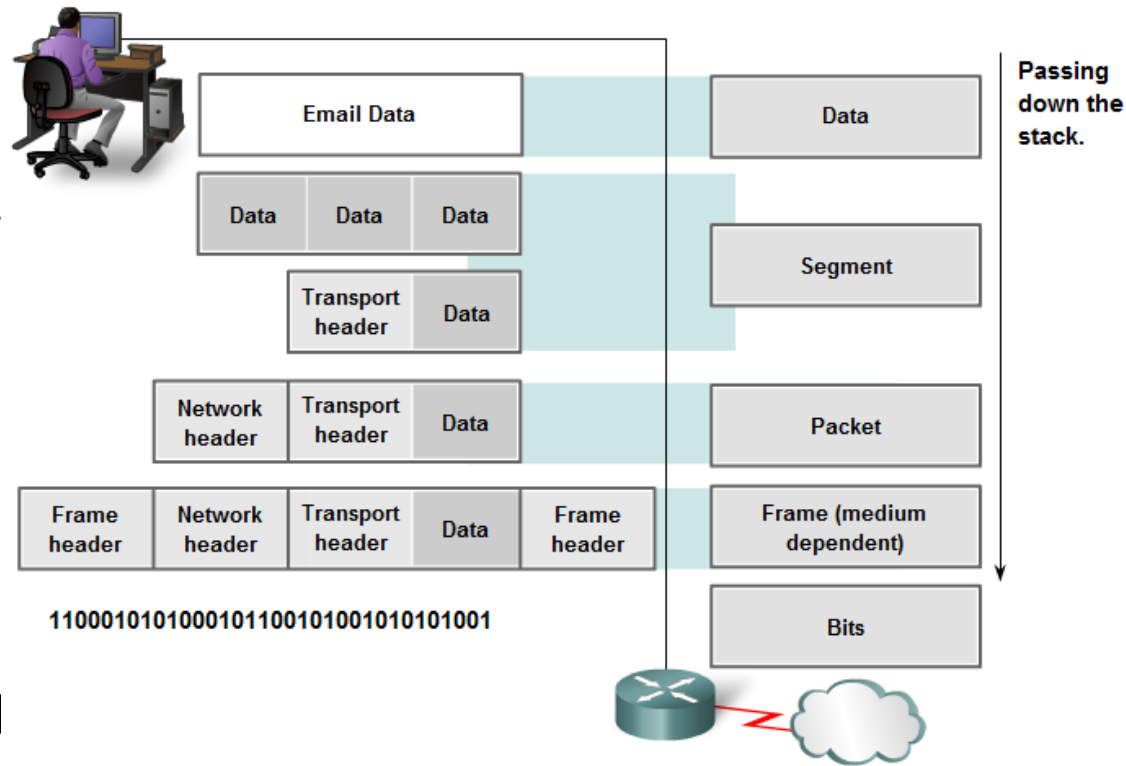
1100010101000101100101001010101001



# The Communication Process - Decapsulation



# The Communication Process



➔ **Protocol Data Unit (PDU)** - The name of the PDU at any layer.

➔ At each stage of the process, a PDU has a different name to reflect its new appearance.

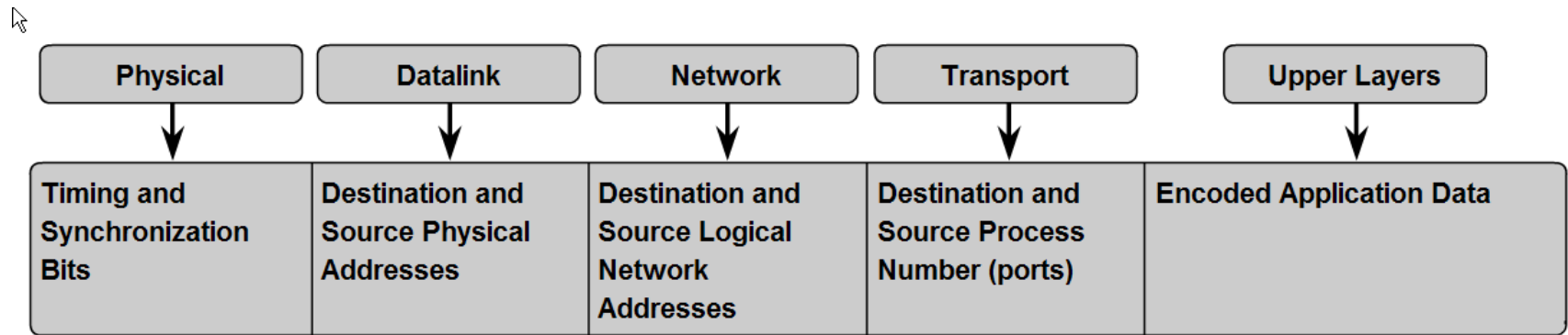
➔ PDUs are named according to the protocols of the TCP/IP suite.

- **Data** - The general term for the PDU used at the Application layer
- **Segment** - Transport Layer PDU
- **Packet** - Internetwork Layer PDU
- **Frame** - Network Access Layer PDU
- **Bits** - A PDU used when physically transmitting data over the medium

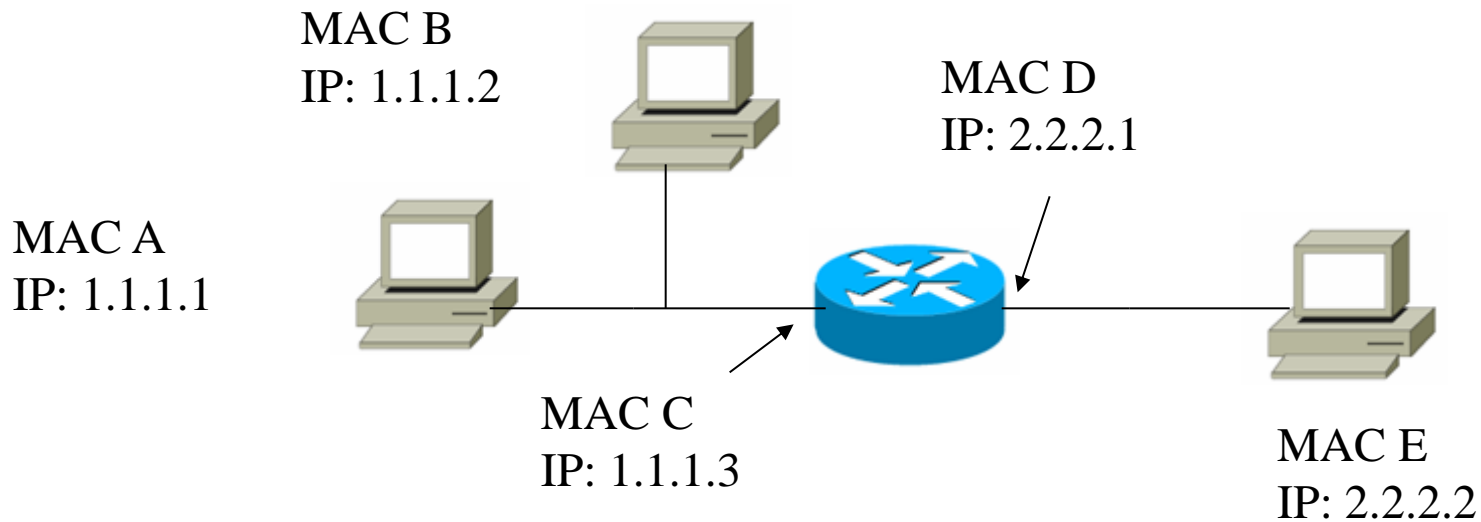


# Addressing and Naming Schemes

➡ Explain how labels in encapsulation headers are used to manage communication in data networks



# Difference Between IP & MAC addresses



# What is the Address on my Ethernet NIC?



C:\WINNT\System32\cmd.exe

Microsoft Windows XP [Version 5.1.2600]  
(C) Copyright 1985-2001 Microsoft Corp.

C:\>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

Connection-specific DNS Suffix . : cabrillo.edu  
IP Address. . . . . : 172.16.22.73  
Subnet Mask . . . . . : 255.255.224.0  
Default Gateway . . . . . : 172.16.1.1

C:\>ipconfig /all

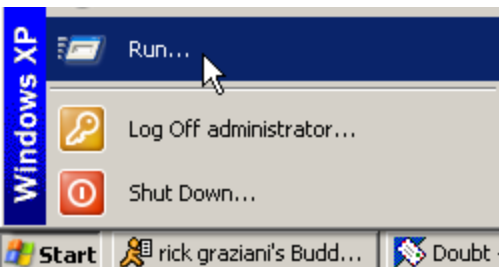
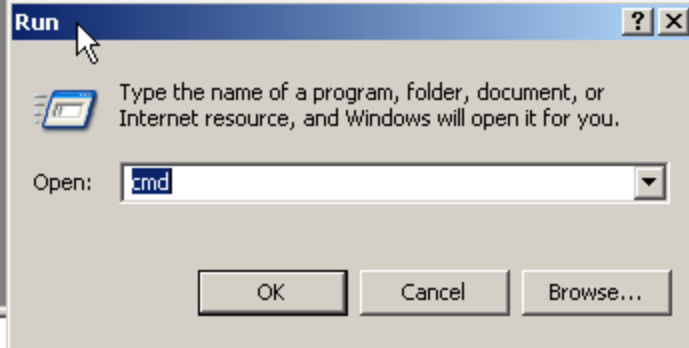
Windows IP Configuration

Host Name . . . . . : RICK-GRAZIANI  
Primary Dns Suffix . . . . . :  
Node Type . . . . . : Hybrid  
IP Routing Enabled. . . . . : No  
WINS Proxy Enabled. . . . . : No

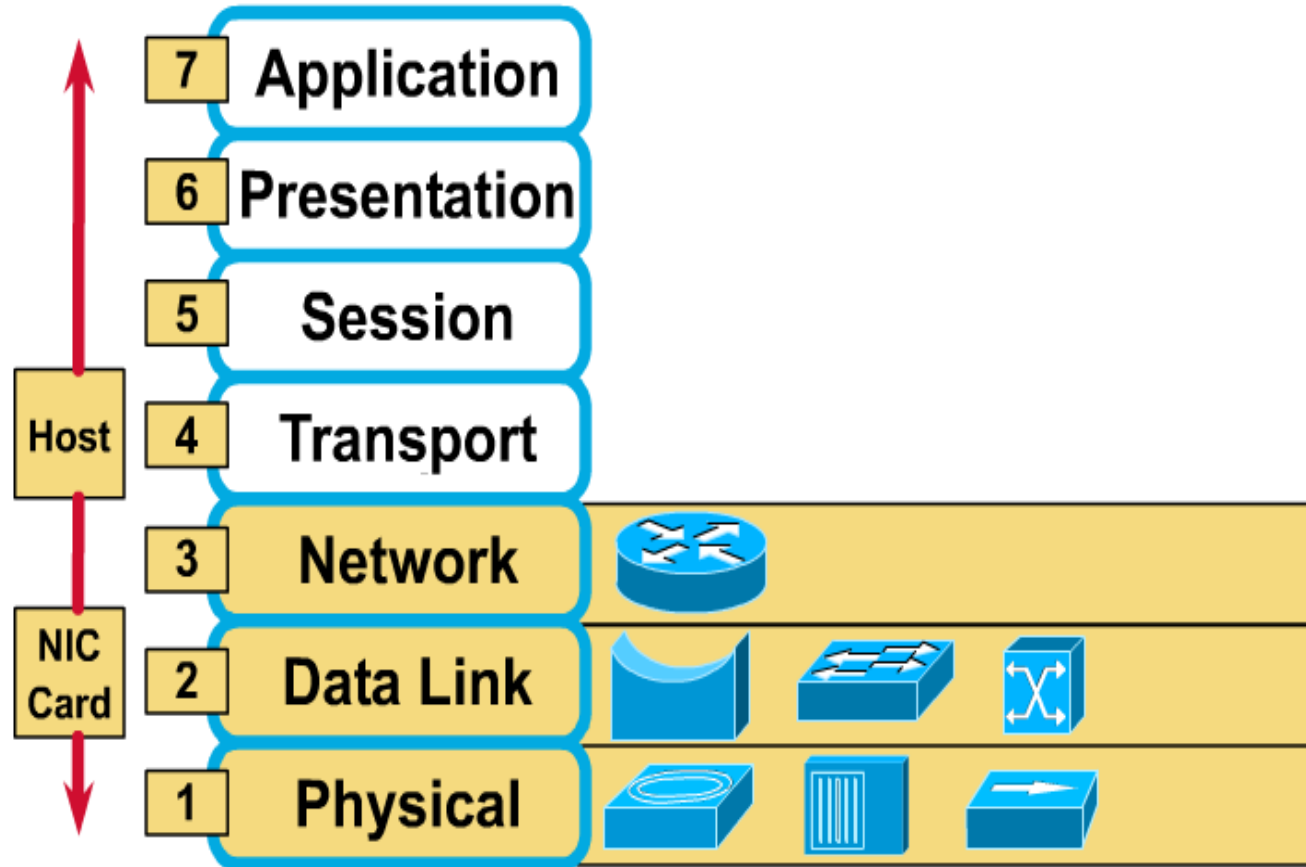
Ethernet adapter Local Area Connection:

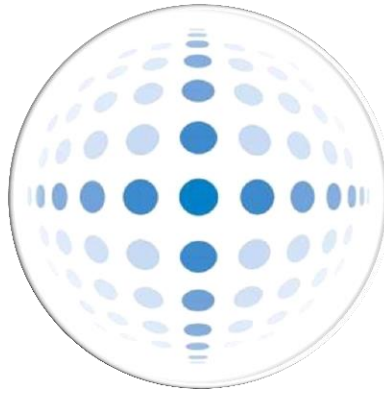
Connection-specific DNS Suffix . : cabrillo.edu  
Description . . . . . : Intel 8255x-based PCI Ethernet Adapt  
(100)  
Physical Address. . . . . : 00-20-E0-6B-17-62  
Dhcp Enabled. . . . . : Yes  
Autoconfiguration Enabled . . . . . : Yes  
IP Address. . . . . : 172.16.22.73  
Subnet Mask . . . . . : 255.255.224.0  
Default Gateway . . . . . : 172.16.1.1  
DHCP Server . . . . . : 172.16.1.7  
DNS Servers . . . . . : 207.62.187.53  
                              207.62.187.54  
Primary WINS Server . . . . . : 171.69.2.87  
Secondary WINS Server . . . . . : 171.68.235.228  
Lease Obtained. . . . . : Wednesday, March 10, 2004 9:48:23 AM  
Lease Expires . . . . . : Saturday, March 13, 2004 9:48:23 AM

C:\>\_



# Network devices capabilities





**Thank you**

